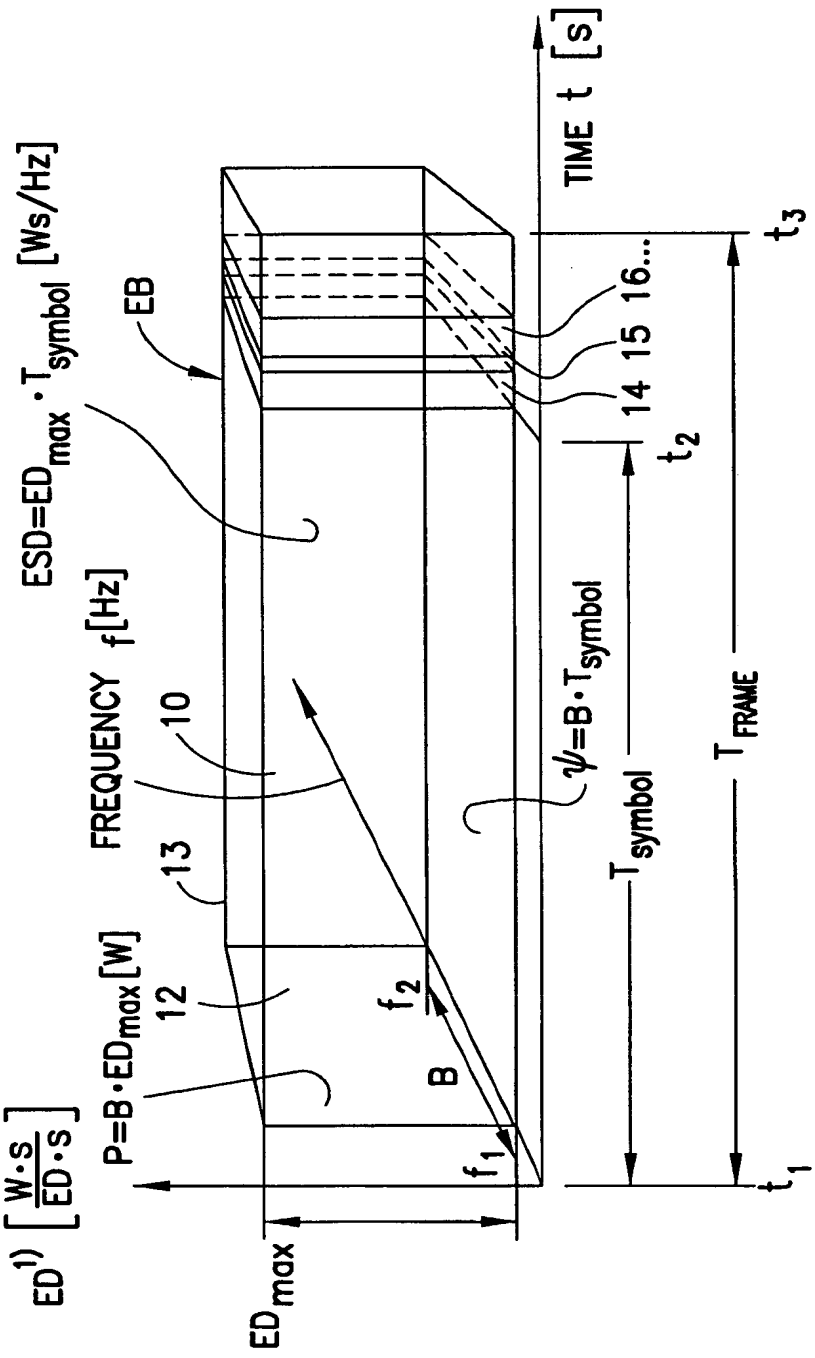


[1] ED: ENERGY DENSITY ACCORDING TO WIGNER–VILLE

FIG.1

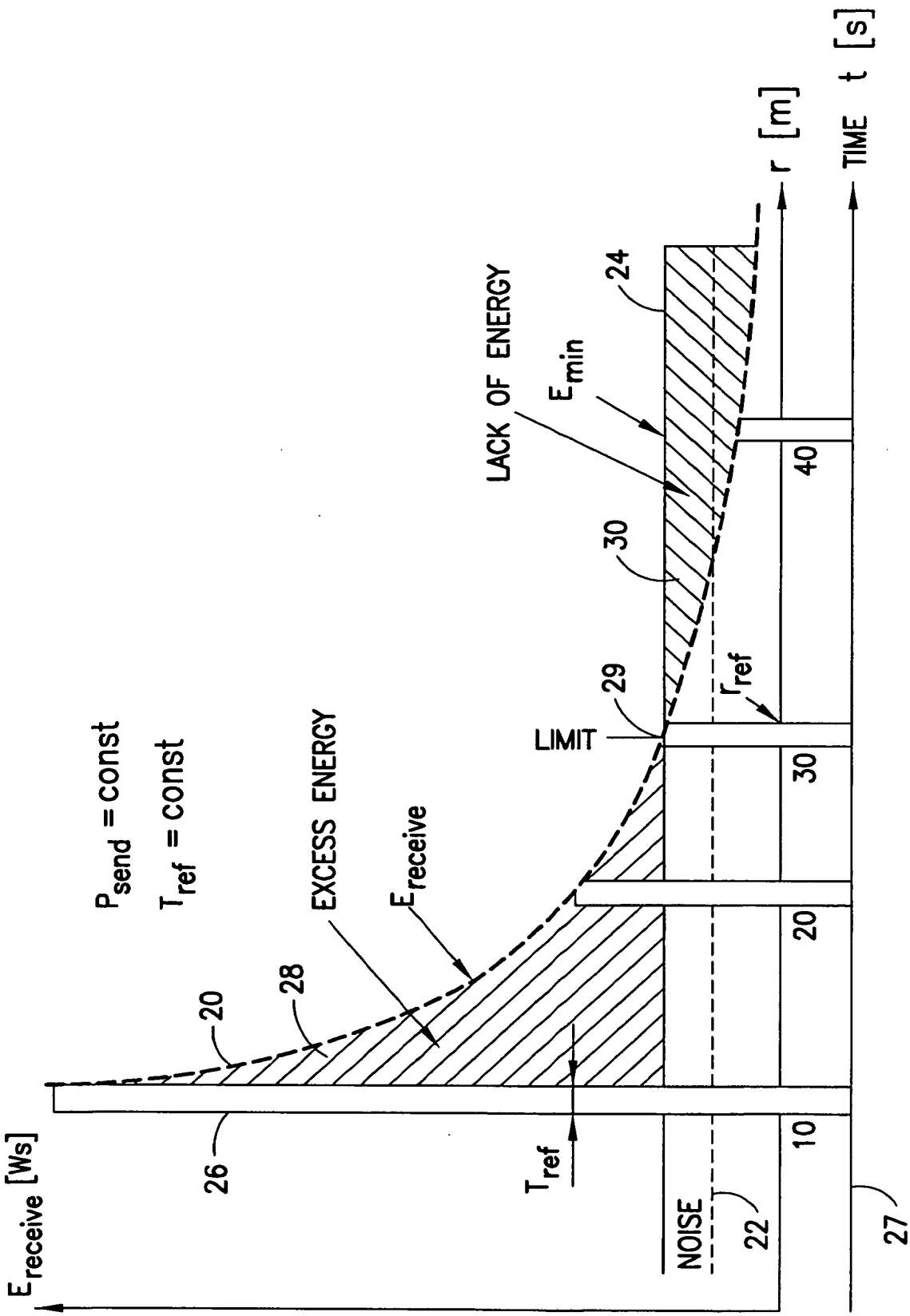

$E_{receive}$ [Ws]
TIME t [s]
r [m]
P_{send} = const
T_{ref} = const
EXCESS ENERGY
$E_{receive}$
LACK OF ENERGY
E_{min}
LIMIT
r_{ref}
T_{ref}
NOISE
20
28
26
24
30
29
22
27
10
20
30
40

FIG.2

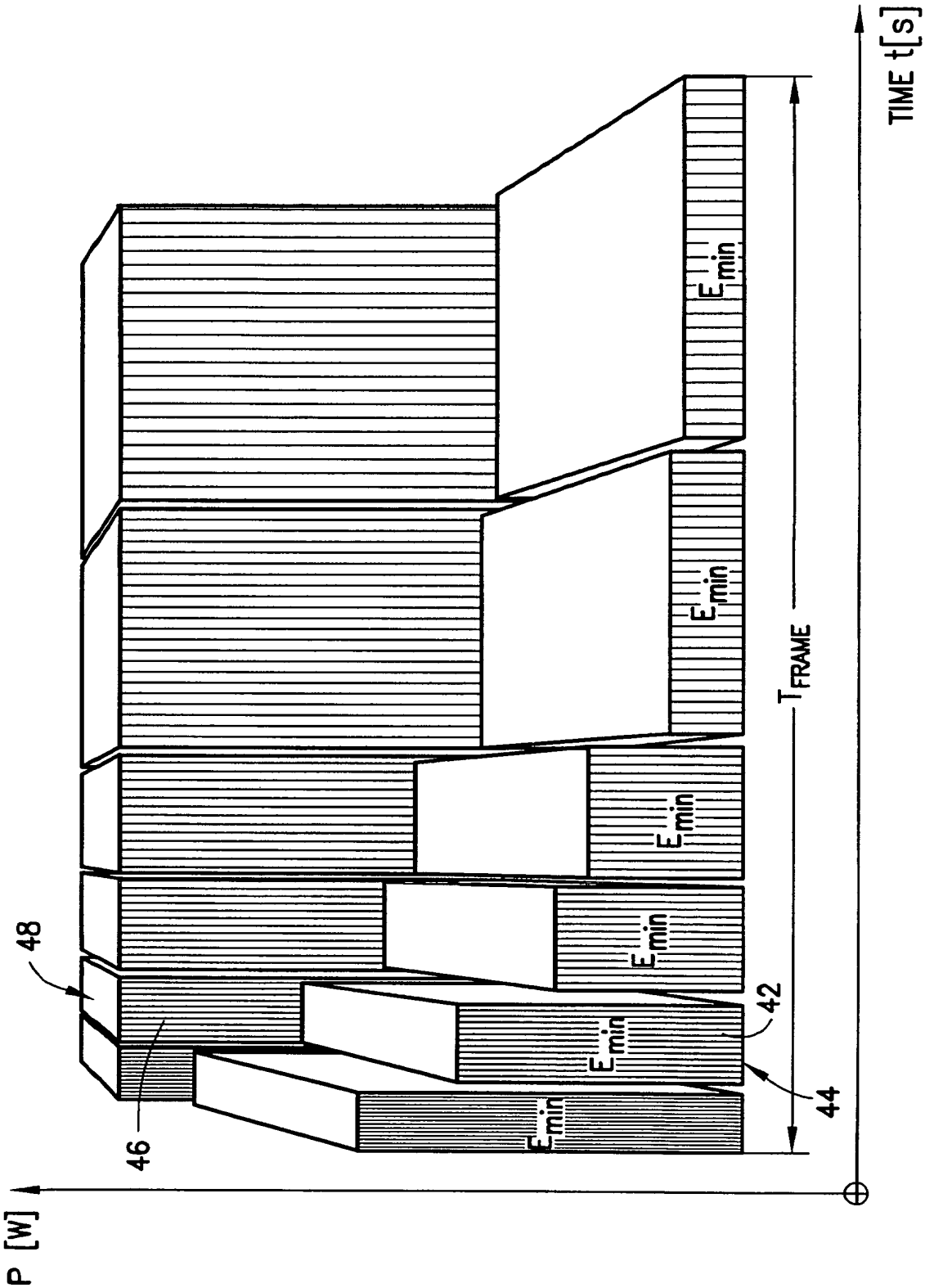


FIG.3

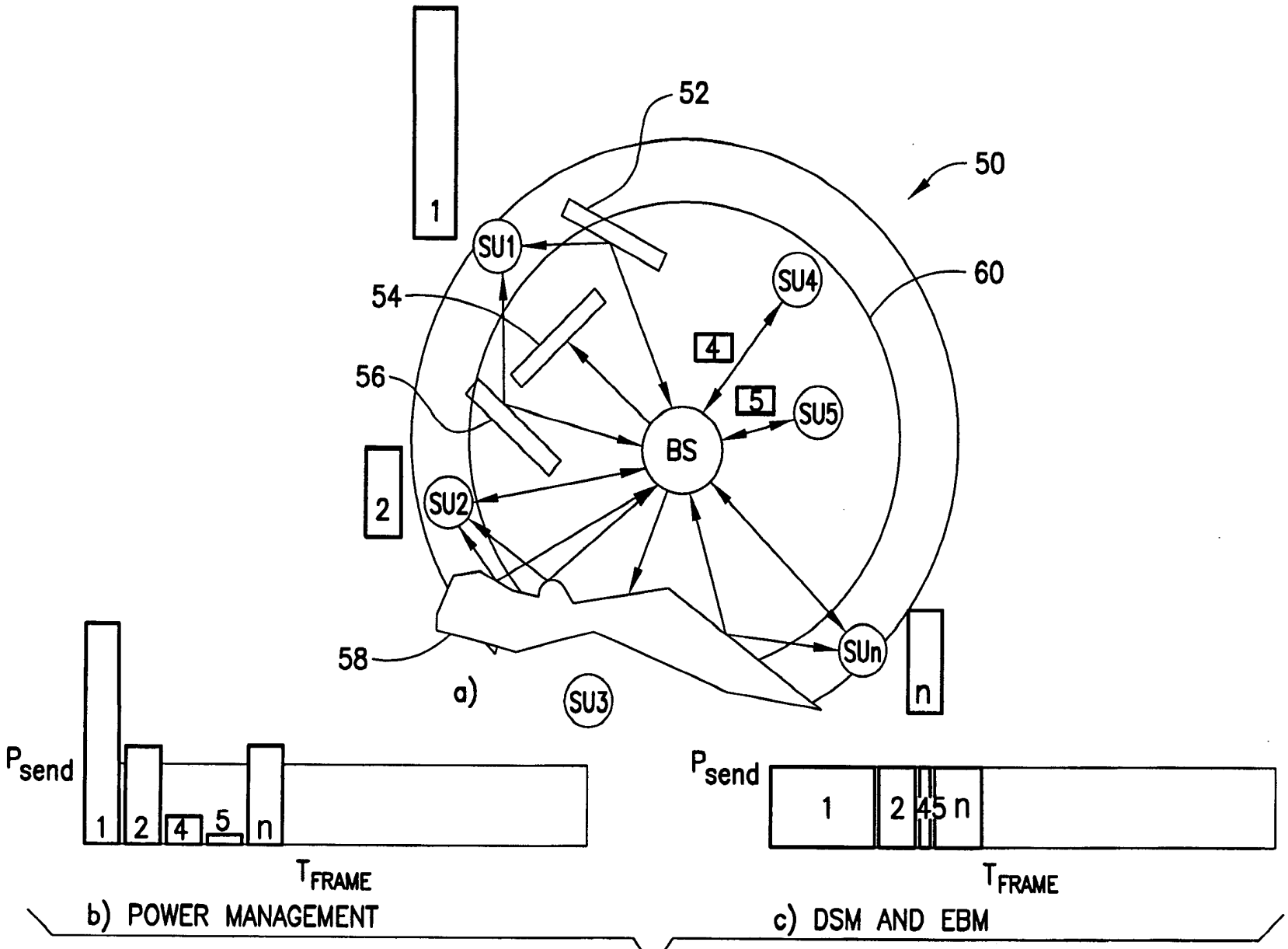


FIG.4

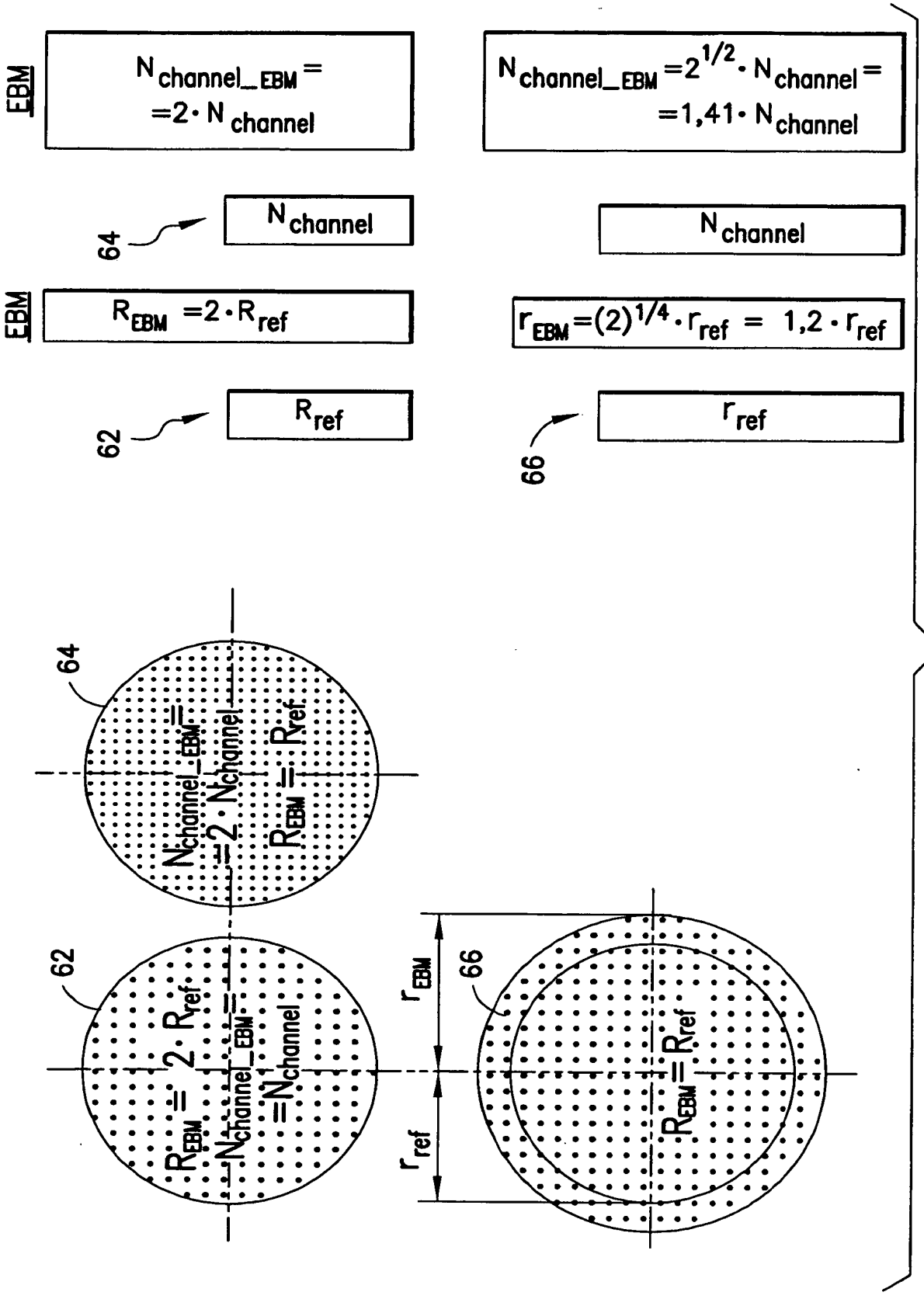

EBM
$N_{channel\_EBM} = 2 \cdot N_{channel}$
$N_{channel\_EBM} = 2^{1/2} \cdot N_{channel} = 1{,}41 \cdot N_{channel}$
64
$N_{channel}$
$N_{channel}$
EBM
$R_{EBM} = 2 \cdot R_{ref}$
$r_{EBM} = (2)^{1/4} \cdot r_{ref} = 1{,}2 \cdot r_{ref}$
62
R_{ref}
66
r_{ref}
64
$N_{channel\_EBM} = 2 \cdot N_{channel}$
$R_{EBM} = R_{ref}$
62
$R_{EBM} = 2 \cdot R_{ref}$
$N_{channel\_EBM} = N_{channel}$
r_{EBM}
66
r_{ref}
$R_{EBM} = R_{ref}$

FIG.5

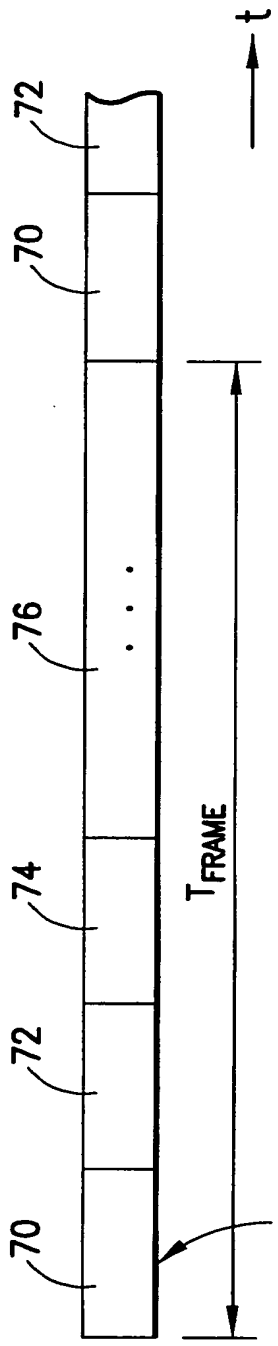

t
72
70
76
74
72
70
T_{FRAME}
Tchannel

FIG.6

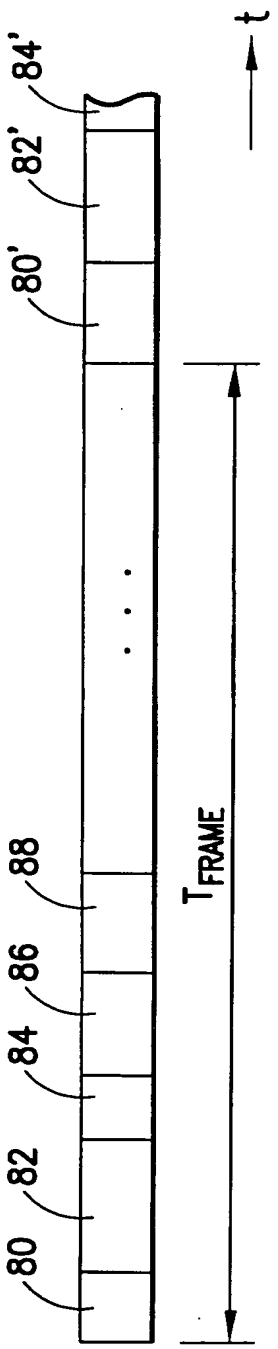
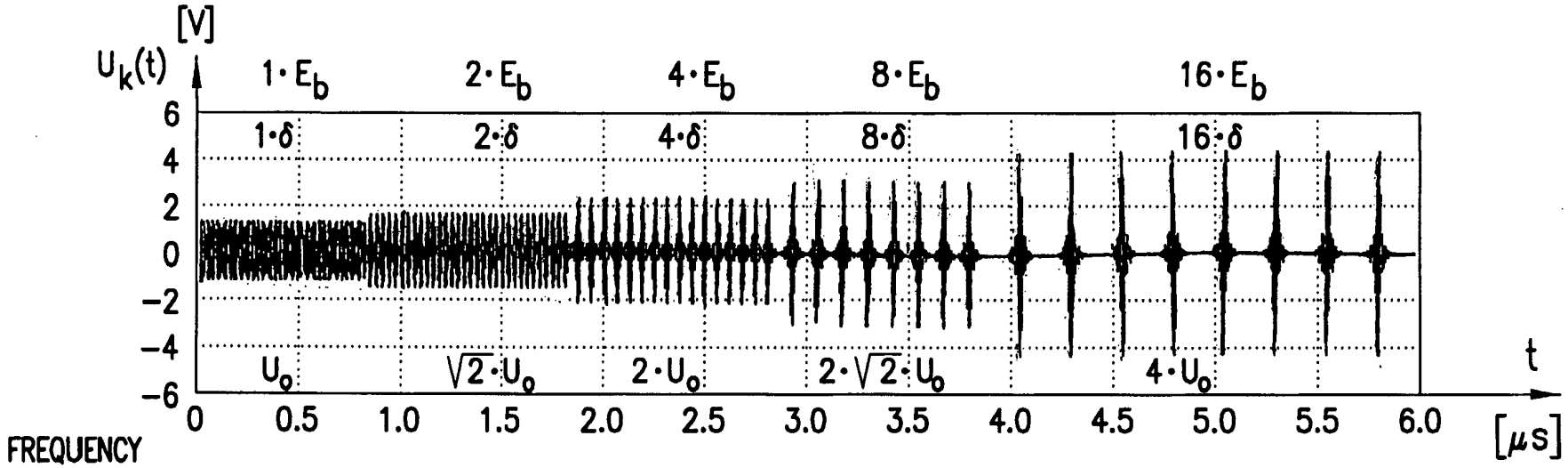

t
84'
82'
80'
88
86
84
82
80
T_{FRAME}

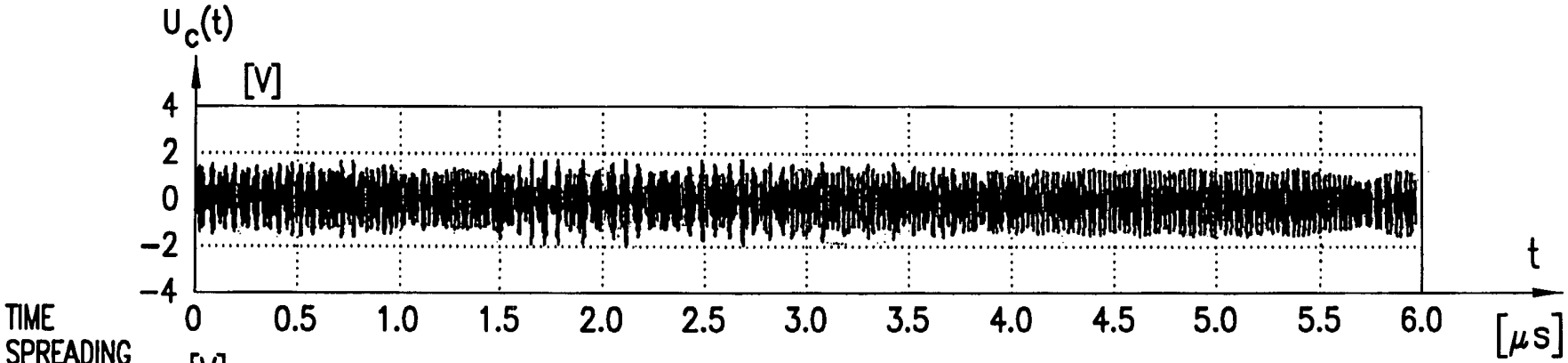
FIG.7



FREQUENCY SPREADING

$$\nu = \frac{B}{R}$$

FIG.8a



TIME SPREADING

$$\psi = \frac{T_{Chirp}}{\delta} = T_{Chirp} \cdot B$$

FIG.8b

REPLACEMENT SHEET

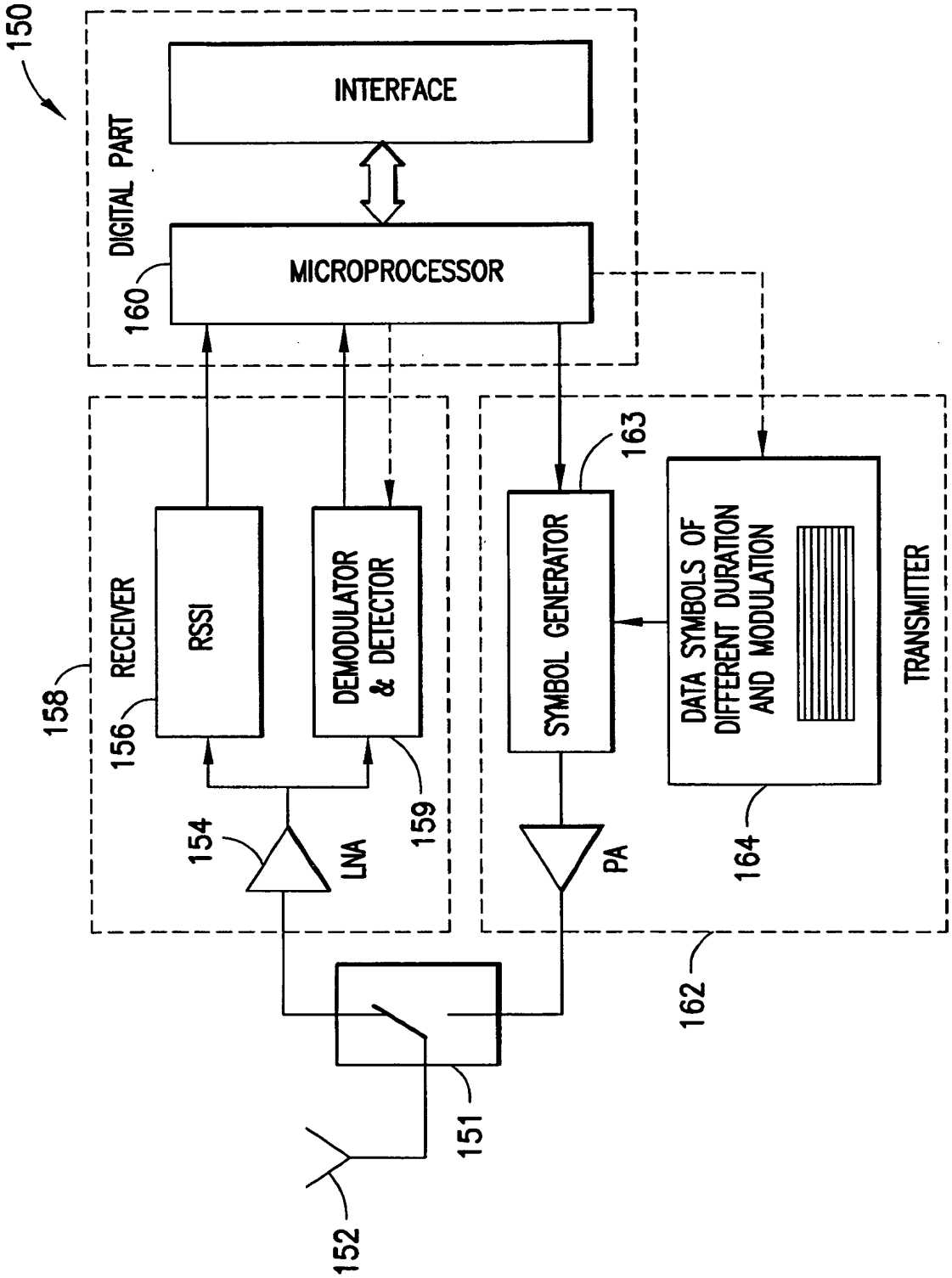

150
DIGITAL PART
INTERFACE
MICROPROCESSOR
160
158
RECEIVER
156
RSSI
DEMODULATOR & DETECTOR
159
154
LNA
163
SYMBOL GENERATOR
DATA SYMBOLS OF DIFFERENT DURATION AND MODULATION
164
PA
TRANSMITTER
162
151
152

FIG.9

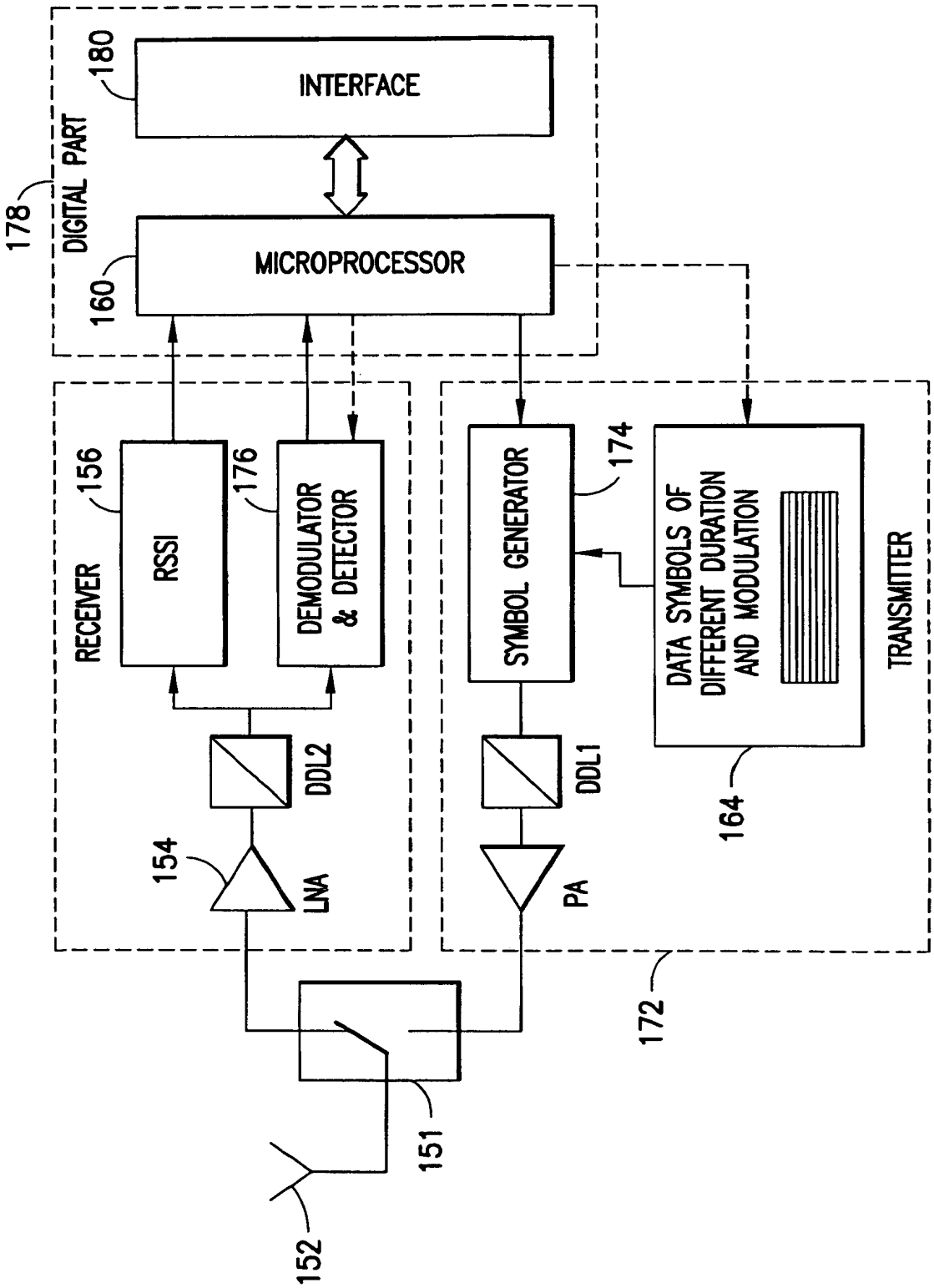

178
DIGITAL PART
180
INTERFACE
160
MICROPROCESSOR
RECEIVER
156
RSSI
176
DEMODULATOR & DETECTOR
DDL2
154
LNA
TRANSMITTER
174
SYMBOL GENERATOR
DDL1
PA
DATA SYMBOLS OF DIFFERENT DURATION AND MODULATION
164
172
151
152

FIG.10

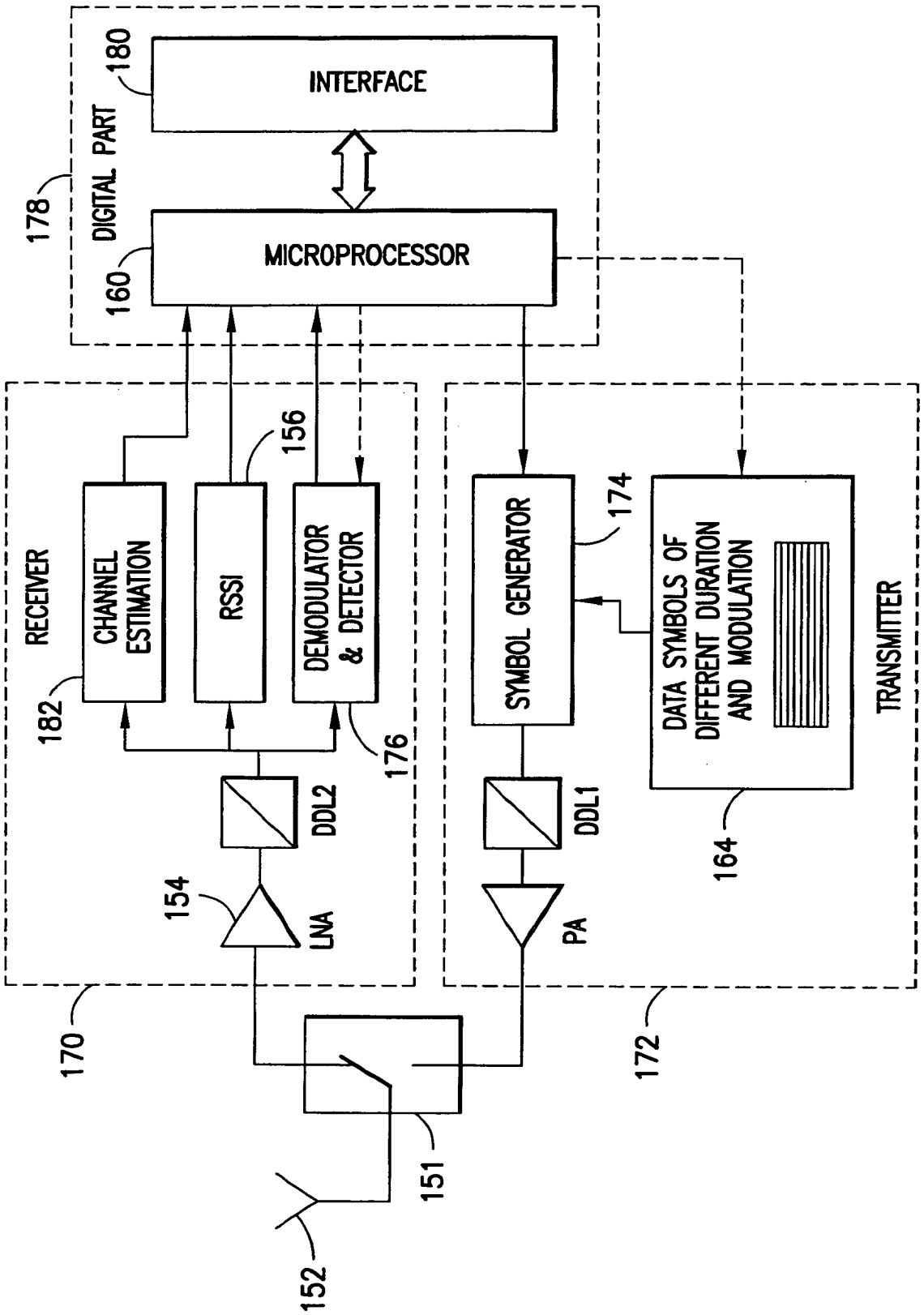

INTERFACE
180
DIGITAL PART
178
MICROPROCESSOR
160
RECEIVER
CHANNEL ESTIMATION
RSSI
DEMODULATOR & DETECTOR
156
182
176
DDL2
154
LNA
170
SYMBOL GENERATOR
174
DATA SYMBOLS OF DIFFERENT DURATION AND MODULATION
TRANSMITTER
DDL1
PA
164
172
151
152

FIG.11

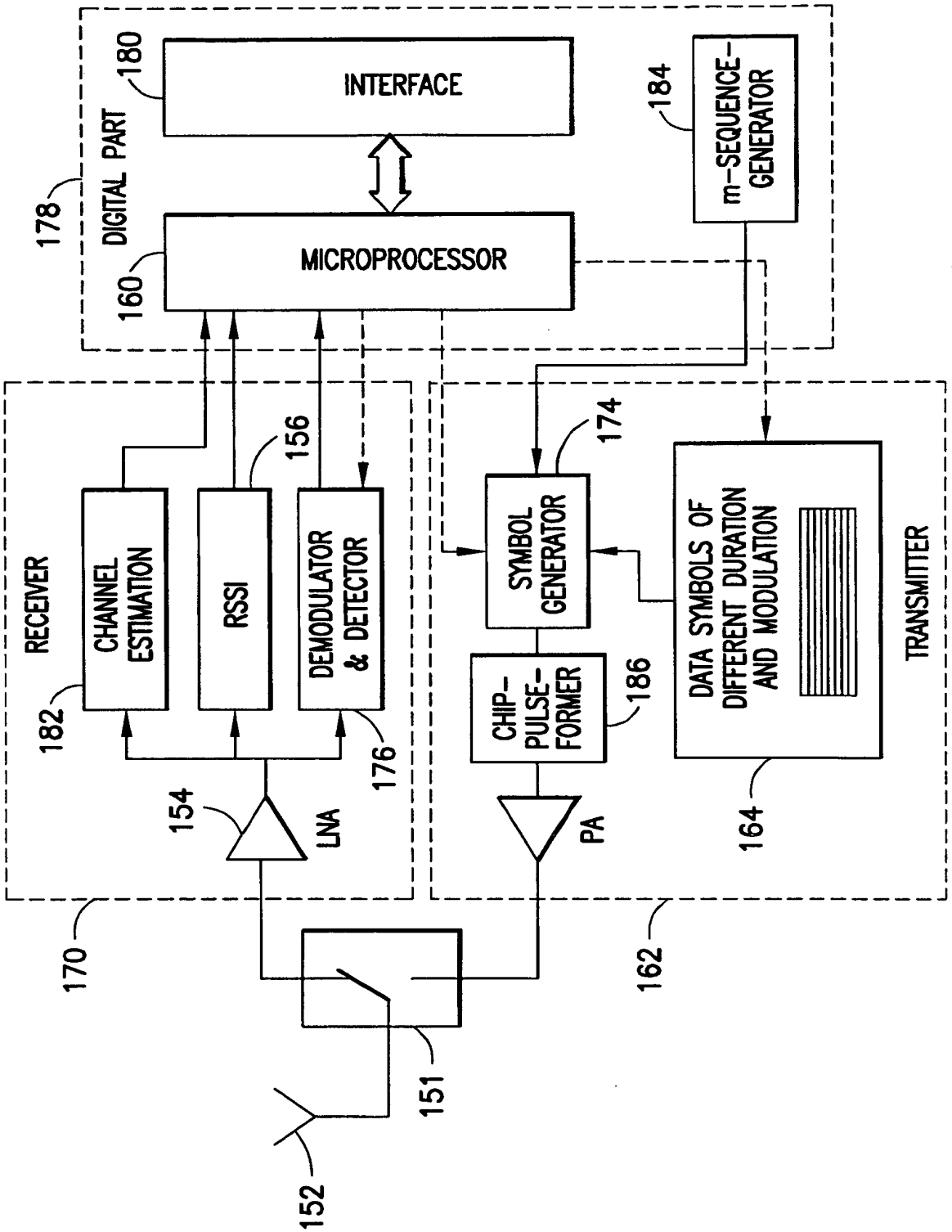
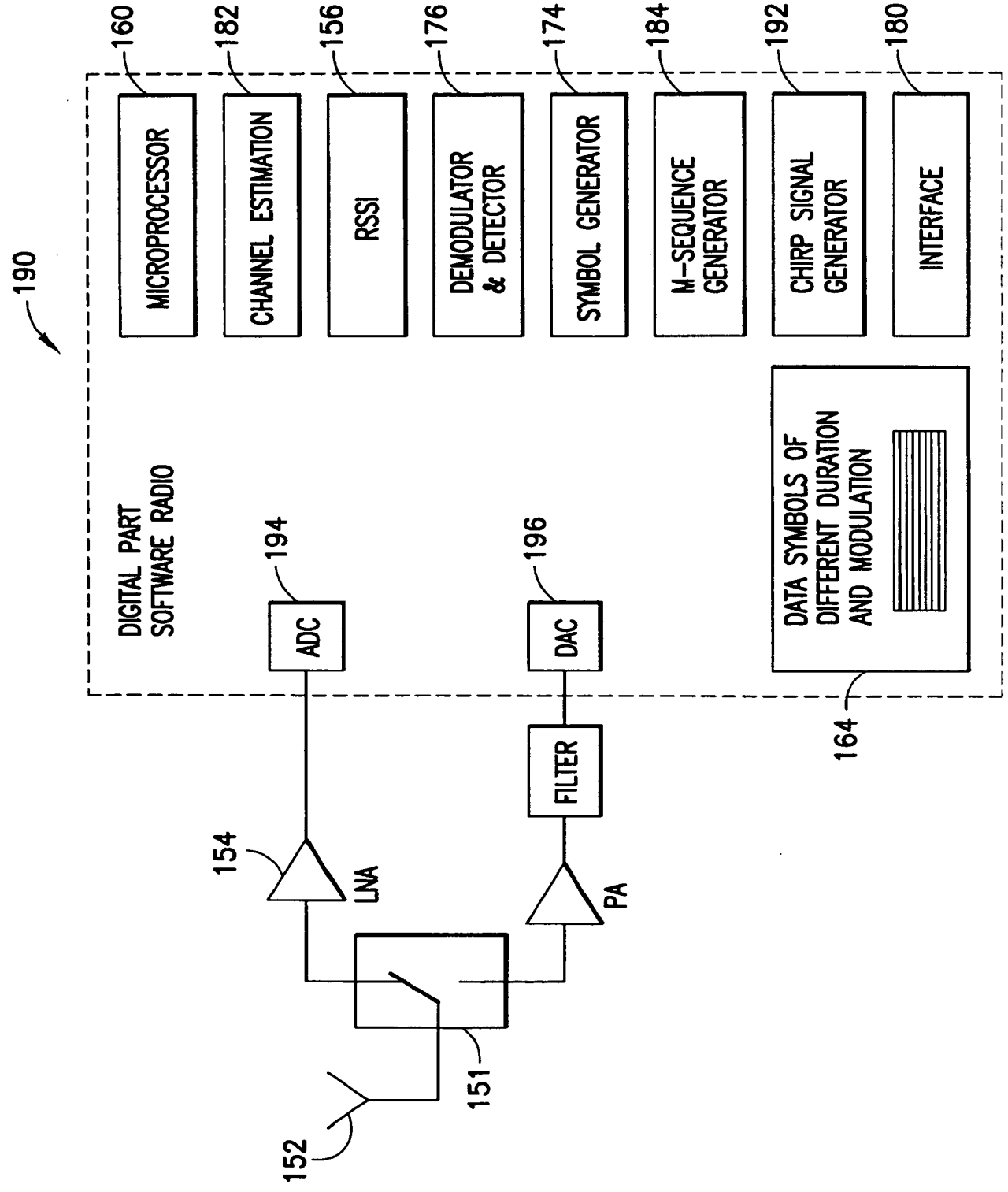

DIGITAL PART
178
INTERFACE
180
MICROPROCESSOR
160
m-SEQUENCE-GENERATOR
184
RECEIVER
CHANNEL ESTIMATION
182
RSSI
156
DEMODULATOR & DETECTOR
176
LNA
154
SYMBOL GENERATOR
174
CHIP-PULSE-FORMER
186
PA
DATA SYMBOLS OF DIFFERENT DURATION AND MODULATION
164
TRANSMITTER
170
162
151
152

FIG.12

FIG.13


190
160
MICROPROCESSOR
182
CHANNEL ESTIMATION
156
RSSI
176
DEMODULATOR & DETECTOR
174
SYMBOL GENERATOR
184
M-SEQUENCE GENERATOR
192
CHIRP SIGNAL GENERATOR
180
INTERFACE
DIGITAL PART SOFTWARE RADIO
DATA SYMBOLS OF DIFFERENT DURATION AND MODULATION
164
194
ADC
196
DAC
FILTER
154
LNA
PA
151
152

NEW SHEET

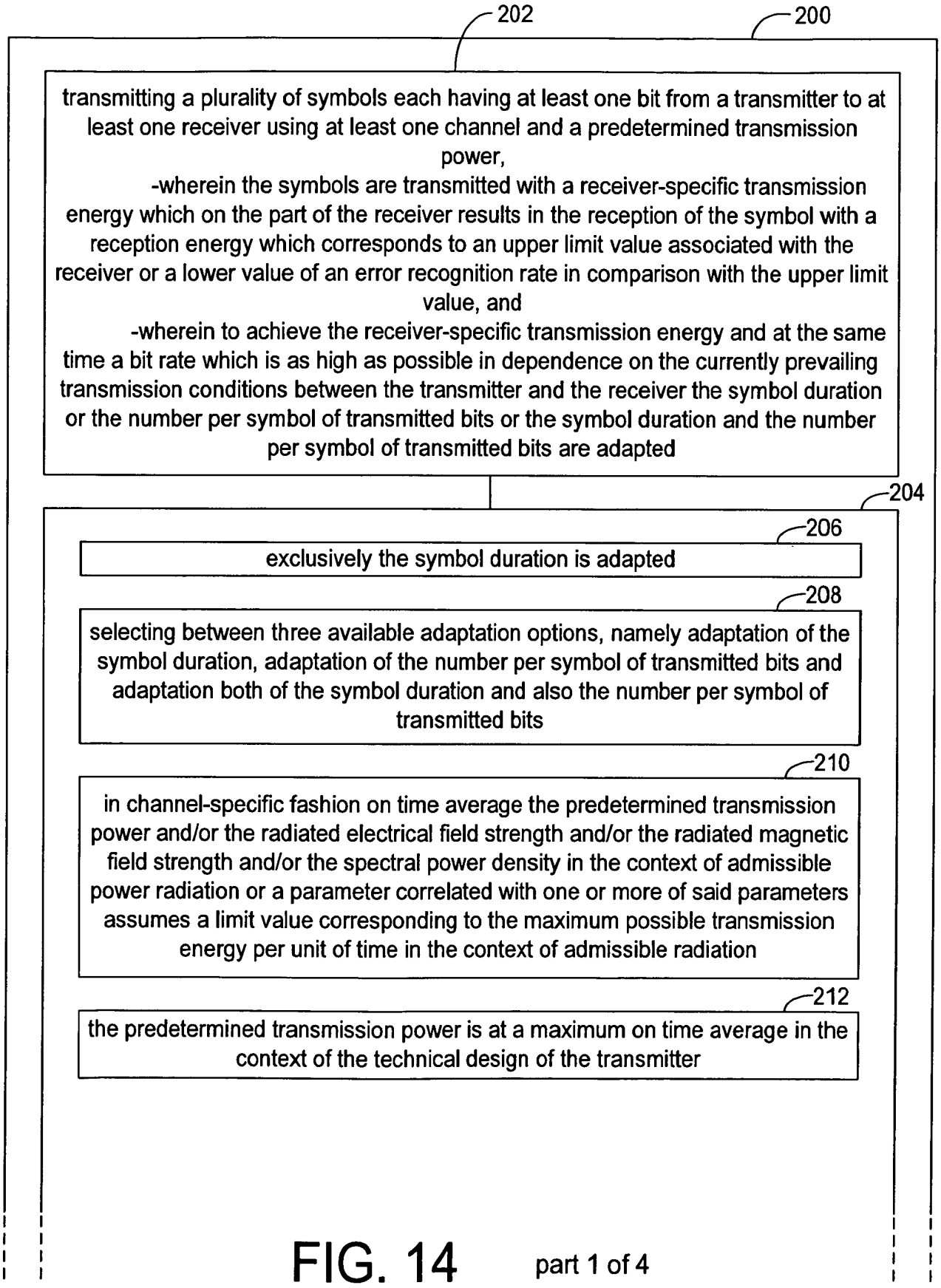


FIG. 14 part 1 of 4

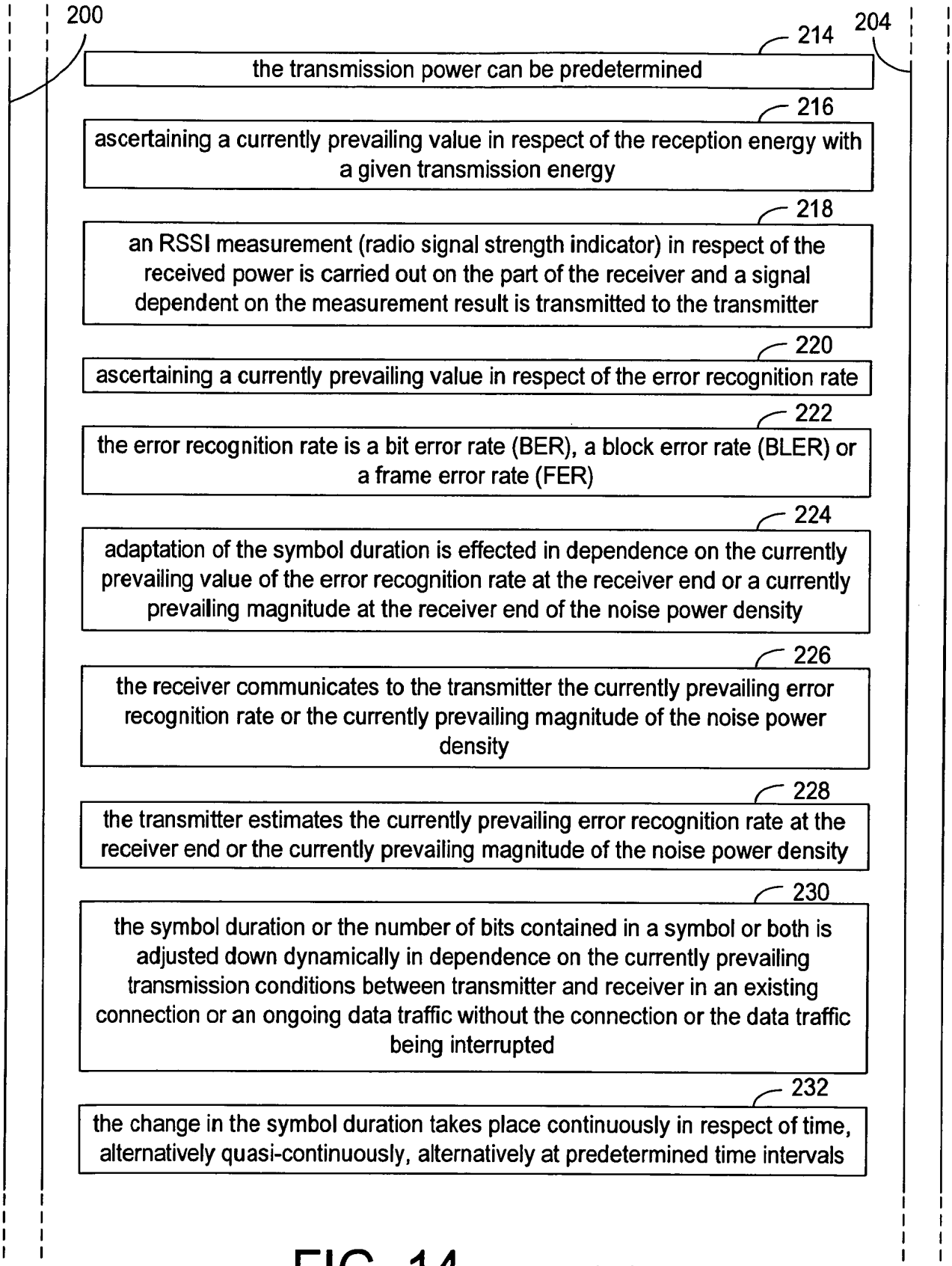


FIG. 14 part 2 of 4

200

204

234

the symbol duration is adapted in channel-specific fashion, that is to say individually on each channel used

236

the symbol duration is restricted towards short symbol duration values in channel-specific fashion by the bandwidth of the channel

238

the symbol duration is determined from a continuous value spectrum

240

the symbol duration is determined from a discrete value spectrum, wherein the discrete value spectrum contains the integral multiples of a symbol duration which is the shortest possible in channel-specific relationship

242

the symbol duration T_{symbol} is determined at the transmitter end in accordance with the formula:

$$T_{symbol} = \frac{E_{\min} \cdot \left(r / r_0 \right)^{\alpha}}{P_{send}}$$

wherein E_{min} is the reception energy corresponding to the upper limit value associated with the receiver in respect of the error recognition rate, P_{send} is the maximum transmission power, r is the distance between transmitter and receiver, r_0 is a reference distance and α is a propagation coefficient

244

the selection of the number per symbol of transmitted bits is effected in dependence on the currently prevailing value of the error recognition rate at the receiver end or on a currently prevailing magnitude at the receiver end at the noise power density

246

the number per symbol of transmitted bits is adapted in channel-specific relationship

248

adaptation of the number per symbol of transmitted bits is effected when a symbol duration which is shortest in channel-specific relationship is already used

FIG. 14 part 3 of 4

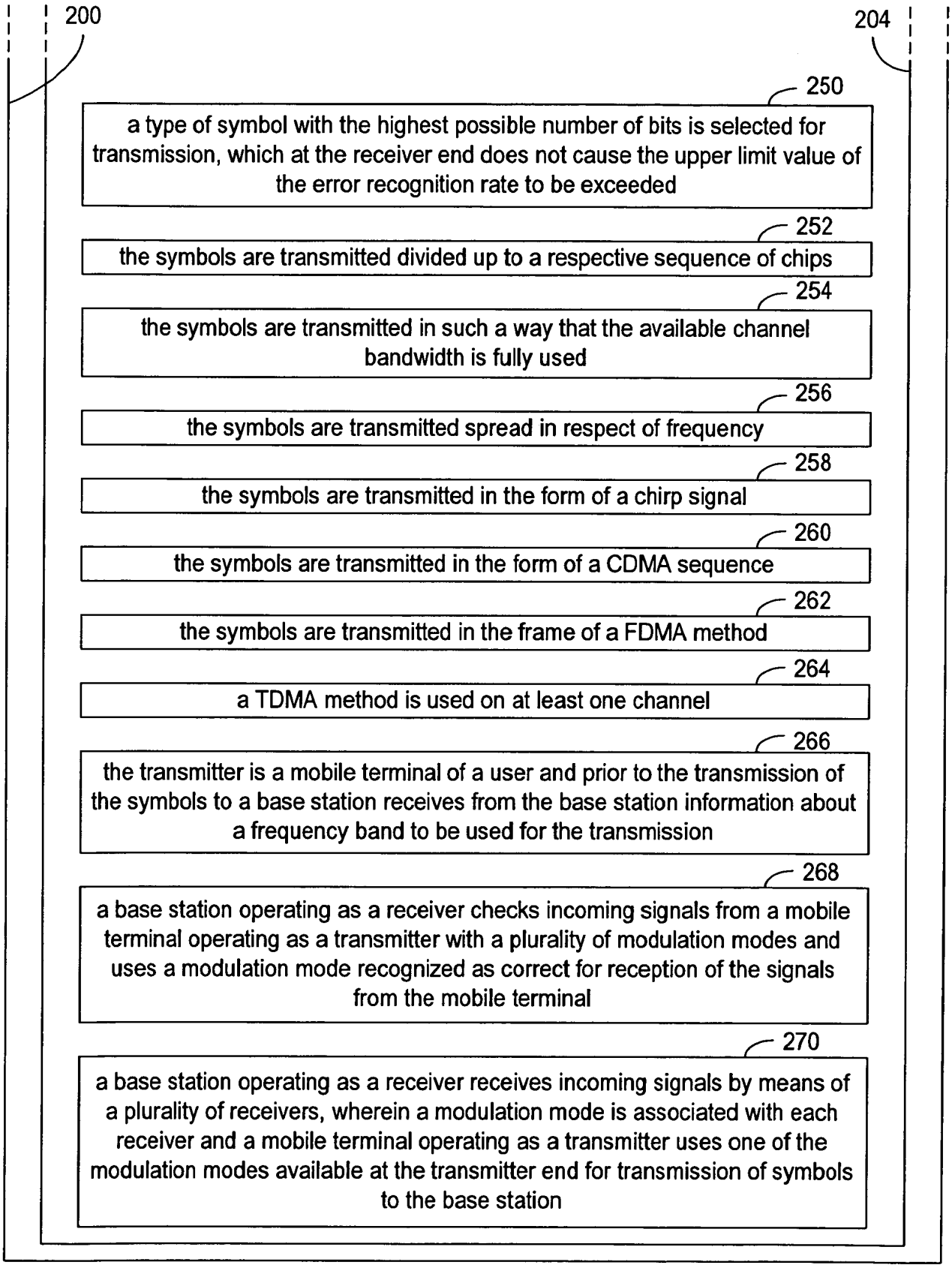


FIG. 14 part 4 of 4

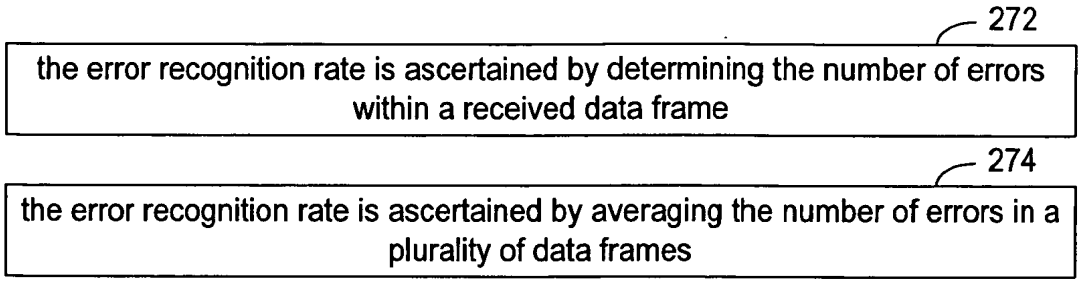


FIG. 14a

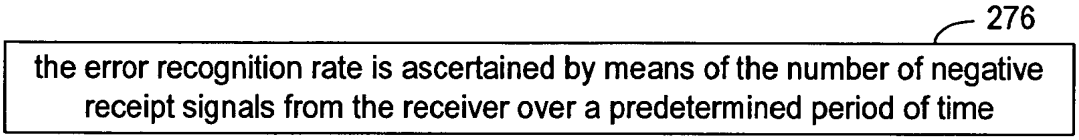


FIG. 14b

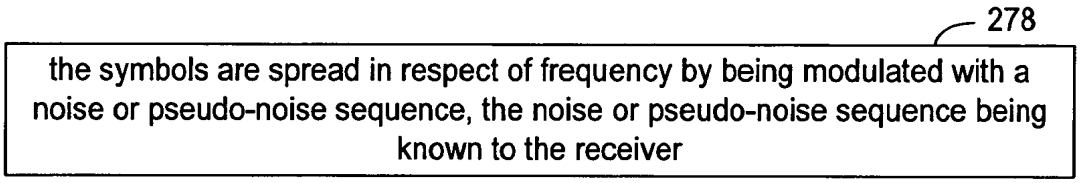


FIG. 14c

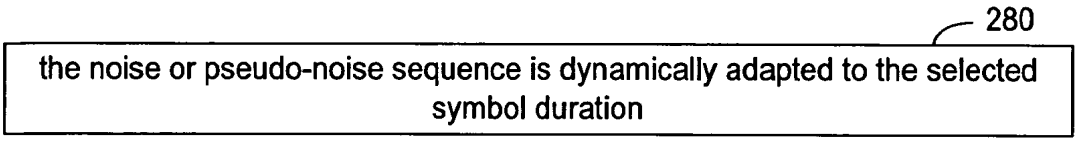


FIG. 14d

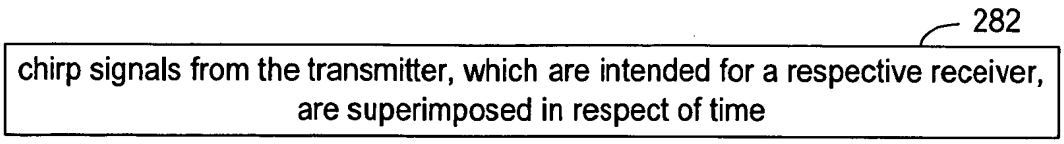


FIG. 14e

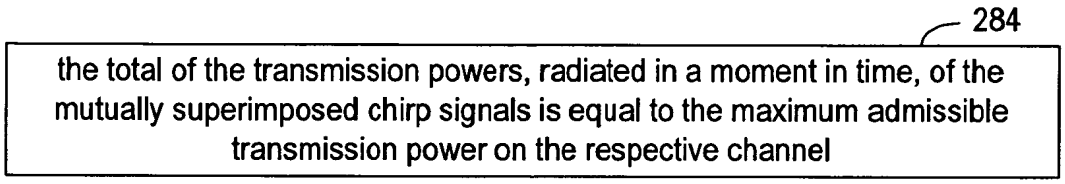


FIG. 14f

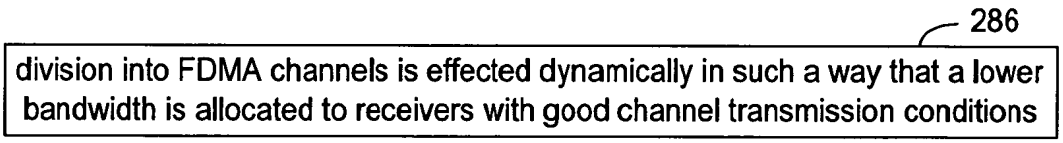


FIG. 14g

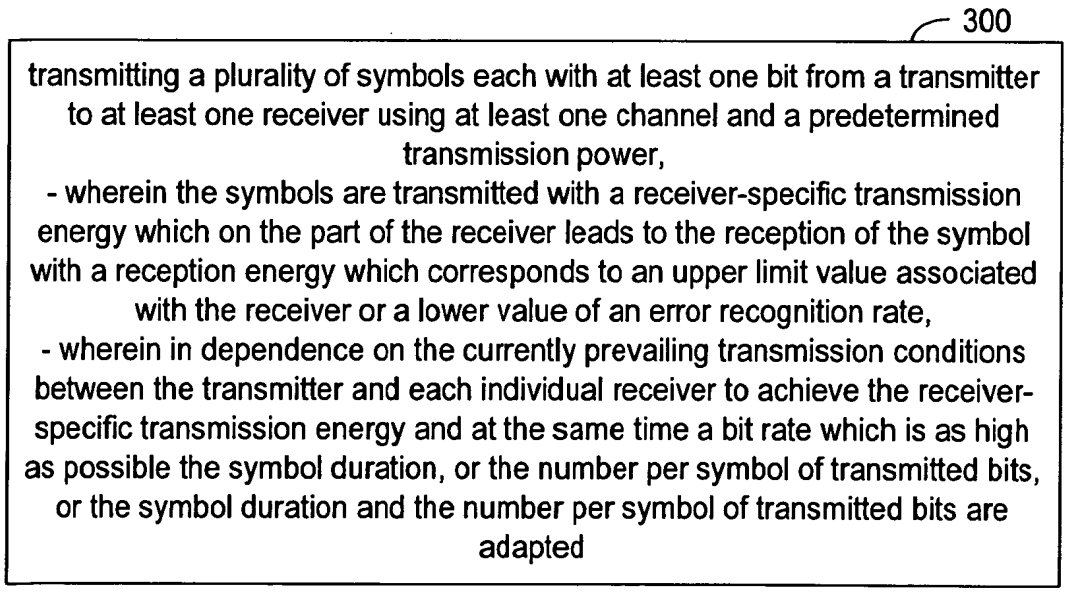


FIG. 15